

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

- 1 1. (Currently amended) A method for communicating between a first
2 semiconductor die and a second semiconductor die through optical signaling,
3 comprising:
4 converting an electrical signal into an optical signal using an electrical-to-
5 optical transducer located on a face of the first semiconductor die, ~~wherein the~~
6 ~~electrical-to-optical transducer is a member of a plurality of electrical-to-optical~~
7 ~~transducers associated with a given channel located on the first semiconductor~~
8 ~~die;~~
9 wherein the first semiconductor die and the second semiconductor die are
10 oriented face-to-face so that the optical signal generated on the first
11 semiconductor die shines on the second semiconductor die;
12 passing the optical signal through annuli located within metal layers on the
13 first semiconductor die to focus the optical signal onto the second semiconductor
14 die;
15 receiving the optical signal on a face of the second semiconductor die; and
16 converting the optical signal into a corresponding electrical signal using an
17 optical-to-electrical transducer located on the face of the second semiconductor
18 die, ~~wherein the optical-to-electrical transducer is a member of a plurality of~~
19 ~~optical-to-electrical transducers associated with the given channel located on the~~
20 ~~second semiconductor die;~~

21 wherein a plurality of optical signals is transmitted in parallel from the
22 ~~first semiconductor die to the second semiconductor die are electronically steered~~
23 ~~to correct misalignments between the first semiconductor die and the second~~
24 ~~semiconductor die.~~

1 2. (Cancelled)

1 3. (Original) The method of claim 1, wherein after generating the optical
2 signal on the first semiconductor die, the method further comprises using a lens to
3 focus the optical signal onto the second semiconductor die.

1 4. (Original) The method of claim 1, wherein after generating the optical
2 signal on the first semiconductor die, the method further comprises using a mirror
3 to reflect the optical signal, so that the optical signal can shine on the second
4 semiconductor die without the first semiconductor die having to be coplanar with
5 the second semiconductor die.

1 5-6 (Canceled).

1 7. (Previously presented) The method of claim 1,
2 wherein multiple spatially adjacent electrical-to-optical transducers in the
3 plurality of electrical-to-optical transducers transmit the same signal; and
4 wherein electronic steering circuits in the first semiconductor die direct
5 data to the multiple spatially adjacent electrical-to-optical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 8. (Previously presented) The method of claim 1,

2 wherein multiple spatially adjacent optical-to-electrical transducers in the
3 plurality of optical-to-electrical transducers receive the same signal; and
4 wherein electronic steering circuits in the second semiconductor die direct
5 data from the multiple spatially adjacent optical-to-electrical transducers to correct
6 mechanical misalignment in X , Y and Θ coordinates.

1 9. (Original) The method of claim 1, wherein the electrical-to-optical
2 transducer includes one of:
3 a Zener diode;
4 a light emitting diode (LED);
5 a vertical cavity surface emitting laser (VCSEL); and
6 an avalanche breakdown P-N diode.

1 10. (Original) The method of claim 1, wherein the optical-to-optical
2 transducer includes one of:
3 a P-N-diode photo-detector; and
4 a P-I-N-diode photo-detector.

1 11. (Currently amended) An apparatus for communicating between
2 semiconductor chips through optical signaling, comprising:
3 a first semiconductor die;
4 a second semiconductor die;
5 an electrical-to-optical transducer located on a face of the first
6 semiconductor die, which is configured to convert an electrical signal into an
7 optical signal, ~~wherein the electrical-to-optical transducer is a member of a~~
8 ~~plurality of electrical-to-optical transducers associated with a given channel~~
9 ~~located on the first semiconductor die;~~

10 wherein the first semiconductor die and the second semiconductor die are
11 oriented face-to-face so that the optical signal generated on the first
12 semiconductor die shines on the second semiconductor die;
13 annuli located within metal layers on the first semiconductor die
14 configured to focus the optical signal onto the second semiconductor die;
15 an optical-to-electrical transducer located on a face of the second
16 semiconductor die, which is configured to convert the optical signal received from
17 the first semiconductor die into a corresponding electrical signal, ~~wherein the~~
18 ~~optical-to-electrical transducer is a member of a plurality of optical-to-electrical~~
19 ~~transducers associated with the given channel located on the second~~
20 ~~semiconductor die;~~
21 ~~wherein a plurality of optical signals is transmitted in parallel from the~~
22 ~~first semiconductor die to the second semiconductor die are electronically steered~~
23 ~~to correct misalignments between the first semiconductor die and the second~~
24 ~~semiconductor die.~~

1 12. (Cancelled)

1 13. (Original) The apparatus of claim 11, further comprising a lens
2 configured to focus the optical signal onto the second semiconductor die.

1 14. (Original) The apparatus of claim 11, further comprising a mirror
2 configured to reflect the optical signal, so that the optical signal can shine on the
3 second semiconductor die without the first semiconductor die having to be
4 coplanar with the second semiconductor die.

1 15-16 (Canceled).

1 17. (Previously presented) The apparatus of claim 11,
2 wherein multiple spatially adjacent electrical-to-optical transducers in the
3 plurality of electrical-to-optical transducers transmit the same signal; and
4 wherein electronic steering circuits in the first semiconductor die direct
5 data to the multiple spatially adjacent electrical-to-optical transducers to correct
6 mechanical misalignment in X , Y and Θ coordinates.

1 18. (Previously presented) The apparatus of claim 11,
2 wherein multiple spatially adjacent optical-to-electrical transducers in the
3 plurality of optical-to-electrical transducers receive the same signal; and
4 wherein electronic steering circuits in the second semiconductor die direct
5 data from the multiple spatially adjacent optical-to-electrical transducers to correct
6 mechanical misalignment in X , Y and Θ coordinates.

1 19. (Original) The apparatus of claim 11, wherein the electrical-to-optical
2 transducer includes one of:
3 a Zener diode;
4 a light emitting diode (LED);
5 a vertical cavity surface emitting laser (VCSEL); and
6 an avalanche breakdown P-N diode.

1 20. (Original) The apparatus of claim 11, wherein the optical-to-optical
2 transducer includes one of:
3 a P-N-diode photo-detector; and
4 a P-I-N-diode photo-detector.

1 21. (Currently amended) A computer system including semiconductor
2 chips that communicate with each other through optical signaling, comprising:

3 a first semiconductor die containing one or more processors;
4 a second semiconductor die containing circuitry that communicates with
5 the one or more processors;
6 an electrical-to-optical transducer located on a face of the first
7 semiconductor die, which is configured to convert an electrical signal into an
8 optical signal, ~~wherein the electrical-to-optical transducer is a member of a~~
9 ~~plurality of electrical-to-optical transducers associated with a given channel~~
10 ~~located on the first semiconductor die;~~
11 wherein the first semiconductor die and the second semiconductor die are
12 oriented face-to-face so that the optical signal generated on the first
13 semiconductor die shines on the second semiconductor die;
14 annuli located within metal layers on the first semiconductor die
15 configured to focus the optical signal onto the second semiconductor die;
16 an optical-to-electrical transducer located on a face of the second
17 semiconductor die, which is configured to convert the optical signal received from
18 the first semiconductor die into a corresponding electrical signal, ~~wherein the~~
19 ~~optical-to-electrical transducer is a member of a plurality of optical-to-electrical~~
20 ~~transducers associated with the given channel located on the second~~
21 ~~semiconductor die;~~
22 ~~wherein a plurality of optical signals is be transmitted in parallel from the~~
23 ~~first semiconductor die to the second semiconductor die are electronically steered~~
24 ~~to correct misalignments between the first semiconductor die and the second~~
25 ~~semiconductor die.~~

1 22. (Cancelled)

1 23. (Original) The computer system of claim 21, further comprising a lens
2 configured to focus the optical signal onto the second semiconductor die.

1 24. (Original) The computer system of claim 21, further comprising a
2 mirror configured to reflect the optical signal, so that the optical signal can shine
3 on the second semiconductor die without the first semiconductor die having to be
4 coplanar with the second semiconductor die.

1 25-26 (Canceled).

1 27. (Previously presented) The computer system of claim 21,
2 wherein multiple spatially adjacent electrical-to-optical transducers in the
3 plurality of electrical-to-optical transducers transmit the same signal; and
4 wherein electronic steering circuits in the first semiconductor die direct
5 data to the multiple spatially adjacent electrical-to-optical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 28. (Previously presented) The computer system of claim 21,
2 wherein multiple spatially adjacent optical-to-electrical transducers in the
3 plurality of optical-to-electrical transducers receive the same signal; and
4 wherein electronic steering circuits in the second semiconductor die direct
5 data from the multiple spatially adjacent optical-to-electrical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 29. (Original) The computer system of claim 21, wherein the electrical-to-
2 optical transducer includes one of:
3 a Zener diode;
4 a light emitting diode (LED);
5 a vertical cavity surface emitting laser (VCSEL); and
6 an avalanche breakdown P-N diode.

1 30. (Original) The computer system of claim 21, wherein the optical-to-
2 optical transducer includes one of:
3 a P-N-diode photo-detector; and
4 a P-I-N-diode photo-detector.

1 31. (Previously presented) The method of claim 1, wherein after
2 generating the optical signal on the first semiconductor die, the method further
3 comprises passing the optical signal through an interposer sandwiched between
4 the first semiconductor die and the second semiconductor die, wherein the
5 interposer contains one or more waveguides that direct the optical signal, so that
6 the optical signal shines on the second semiconductor die.

1 32. (Previously presented) The apparatus of claim 11, further comprising
2 an interposer sandwiched between the first semiconductor die and the second
3 semiconductor die, wherein the interposer contains one or more waveguides that
4 direct the optical signal, so that the optical signal shines on the second
5 semiconductor die.

1 33. (Previously presented) The computer system of claim 21, further
2 comprising an interposer sandwiched between the first semiconductor die and the
3 second semiconductor die, wherein the interposer contains one or more
4 waveguides that direct the optical signal, so that the optical signal shines on the
5 second semiconductor die.

1 34. (New) The method of claim 1,
2 wherein the electrical-to-optical transducer is a member of a plurality of
3 electrical-to-optical transducers located on the first semiconductor die; and

4 wherein the optical-to-electrical transducer is a member of a plurality of
5 optical-to-electrical transducers located on the first semiconductor die;
6 whereby a plurality of optical signals can be transmitted in parallel from
7 the first semiconductor die to the second semiconductor die.

1 35. (New) The apparatus of claim 11,
2 wherein the electrical-to-optical transducer is a member of a plurality of
3 electrical-to-optical transducers located on the first semiconductor die; and
4 wherein the optical-to-electrical transducer is a member of a plurality of
5 optical-to-electrical transducers located on the first semiconductor die;
6 whereby a plurality of optical signals can be transmitted in parallel from
7 the first semiconductor die to the second semiconductor die.

1 36. (New) The computer system of claim 21,
2 wherein the electrical-to-optical transducer is a member of a plurality of
3 electrical-to-optical transducers located on the first semiconductor die; and
4 wherein the optical-to-electrical transducer is a member of a plurality of
5 optical-to-electrical transducers located on the first semiconductor die;
6 whereby a plurality of optical signals can be transmitted in parallel from
7 the first semiconductor die to the second semiconductor die.